

## Intelligent Technology for Exceptional Requirements

### Unipolar disconnector control in the Kazakhstan project

#### ■ The company

The Kazakhstan Electricity Grid Operation Company (KEGOC) is responsible for operating that country's entire electric power supply system. To ensure its continuing economic development, this still-developing country must not only expand its power system but also ensure the reliability of its electric power supply.

#### ■ The starting situation

A vital objective was to improve the reliability of power transmission as well as the availability of the electrical equipment in the power system. KEGOC therefore awarded Siemens Power Transmission and Distribution (PTD) the order to modernize the station control and protection systems for all transformer substations of Kazakhstan's electric power transmission system. But the existing switchgear had to remain in use without changes, which posed a special challenge to the bay controllers, since the switchgear was only suitable for unipolar control.

#### ■ The concept

To maximize system reliability and stability, all 68 transformer substations of the high-voltage and extra-high-voltage level (110 kV to 1150 kV) were equipped with numerical protection and control units and with latest-generation substation control systems. Analog electronic protection relays were replaced by numerical SIPROTEC systems.

These devices were mounted in the switchgear cubicles and then installed directly at the construction sites and commissioned. In addition, in the control rooms of the transformer substations, conventional control panels were replaced by state-of-the-art display workstations for the maintenance personnel. The SICAM SAS substation automation system was used in this application. Based on SICAM and SIPROTEC components, this system provides a uniform solution for the control and monitoring of electrical transmission and distribution systems. Other critical reasons for the Kazakh utility's decision to opt for station control and protection systems from Siemens included the user friendliness of the system components, their reliability, long service life and the



Fig. 1 Substation in Kazakhstan

capability of making operational and diagnostic data available.

#### ■ From practical experience

Our engineers have developed a solution for controlling the existing switchgear with state-of-the-art SIPROTEC 4 bay controllers. A unique approach was used for controlling the disconnectors in the KEGOC system. These disconnectors are operated with a single-pole control scheme in place of a double command for ON and OFF. The actuation direction depends on the momentary status, i.e. when the disconnector is closed, the command will open it. If it is open, the same command will cause it to close. But such a command doesn't exist yet in the DIGSI information catalog.

An additional function of the SIPROTEC relays and controllers will be to provide switching fault protection during manual local operation, using the same contacts that are used for remote control. Fig. 2 illustrates the configuration.

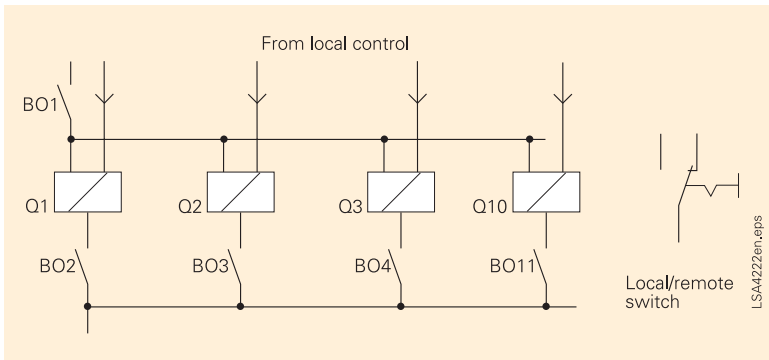


Fig. 2 Disconnector control at KEGOC

The rectangles – Disconnector Q 1 through Disconnector Q10 in the diagram – represent the disconnector connection boxes. These can be controlled either by the instrumentation and control system or by local control (pushbutton directly in the switchgear cubicle). Switching between local and remote control is accomplished by means of the Remote/Local selector (on the right in Fig. 2), which is read by the SIPROTEC relay.

In the "Remote" mode, the disconnectors are controlled by the SIPROTEC relay, i.e. the connections to local control that are represented by arrows are deactivated.

In this mode, every switching command triggers a change in the switchgear status. During these operations, feedback is detected as usual through two binary inputs (OFF, ON, Fault). Disconnector Q1 for instance is turned ON by the contacts BO1 and BO2 when it is OFF, and conversely, is turned OFF when it is ON. These switching operations are performed in accordance with the configured interlock conditions (switching fault protection).

In the "Local" mode, the disconnectors are controlled by pushbuttons directly at the switchgear cubicle. But during this operation too, the interlock conditions in the SIPROTEC must remain in effect. Consequently, when switching the Remote/Local selector to the Local setting, the meaning of the command outputs BO2 through BO11 must be changed: In this situation, SIPROTEC 4 relay closes all contacts that have allocated disconnectors whose interlock conditions are met. This logic allows those disconnectors to be controlled whose switching fault protection condition is being met at a given moment.

### ■ Solution

This complex requirement was swiftly and easily met by virtue of the flexibility of the DIGSI 4 operating program, the CFC editor contained in the program, and the latest device firmware. The approach eliminated the need for a project-specific software expansion (more contacts).

### ■ Connections

1. The unusual disconnector control scheme requires that ON and OFF be connected to one and the same contact. This hasn't been possible in the past. However, a detour via CFC logic can be used to model an incoming command in a specific message that is allocated to a single contact. Disadvantage: At present, the command must be allocated not only to the CFC destination but also to binary outputs in order to be activated for initiation. In new devices (V4.6 or newer) and DIGSI 4.6 this problem is eliminated. Allocation to the binary outputs is no longer necessary.
2. Use of the commands "Q1 ON/OFF" through "Q10 ON/OFF" produces the same log to the control and protection system as usual.
3. The corresponding outputs that are connected to the disconnector contacts "BO2" through "BO11" are actuated via the CFC logic, and so of course is the common contact "BO1".
4. All commands are interlocked; the conditions, which are stored in a separate group within the configuration matrix, are likewise generated in CFC logic.
5. The external Remote/Local selector is detected at a binary input via the "Remote->Local" specific message.
6. In the local control mode ("Local") single commands are also generated in the CFC under the group header Local Release. These single commands represent the interlocking release.



